AD-A212 110

DTIC FILE COPY

(2)

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. Agency Use Only *(Leave blank).*

2. Report Date. 1 April-30 June 89

3. Report Type and Dates Covered. Quarterly Report

4. Title and Subtitle.
Autonomous Ocean Profiler
Quarterly Report

5. Funding Numbers.
Program Element No.
Project No.
Task No.
Accession No.

6. Author(s).
Russ E. Davis

7. Performing Organization Name(s) and Address(es).
University of California
La Jolla, Ca 92093

8. Performing Organization Report Number.
N00014-89-C-6014

9. Sponsoring/Monitoring Agency Name(s) and Address(es).
Naval Ocean Research and Development Activity
Code 330
SSC, MS 39529-5004

10. Sponsoring/Monitoring Agency Report Number.

11. Supplementary Notes.

12a. Distribution/Availability Statement.
Approved for public release; distribution is unlimited.

12b. Distribution Code.

13. Abstract *(Maximum 200 words).*

89 9 8 083

14. Subject Terms.
Autonomous measureing systems, Oceanographic Measurements,
Oceanographic data acquisition. (EDC)

15. Number of Pages. 2

16. Price Code.

17. Security Classification of Report. Unclassified

18. Security Classification of This Page. Unclassified

19. Security Classification of Abstract.

20. Limitation of Abstract.

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. Z39-18
298-102

NORDA (ONR) N00014-89-C-6014
Russ E. Davis

AUTONOMOUS OCEAN PROFILER

Quarterly report 1 April through 30 June 1989

During this period, activity has (as anticipated) focused on three tasks: continued testing and improvement of the basic ALACE float which will do the profiling; preliminary selection of an appropriate set of sensors from which at least sound speed profiles can be determined; development of an improved controller to handle the data stream.

The basic Autonomous Lagrangian Circulation Explorer (ALACE) float is being developed in conjunction with Webb Research Corporation under separate funding. One deployed in the Pacific has cycled to about 400 meters depth every four days since the middle of December 1988. Another deployed in the tropical Atlantic has been profiling from 650 meters since mid-March of this year on a 14 day cycle. These successes show that the basic design is sound and that the design objective of 50 cycles over several years is feasible. But in each case the successful float was launched with another which failed to operate properly, in one case never making Argos contact and in the other failing after one month. Under NSF funding we and Webb Research are working constantly to improve various design and manufacture weaknesses and we are planning a substantial deployment in December as the first truly operational use.

Under this project, a recent graduate of the Scripps Ph.D. program in Applied Ocean Science, Jeff Sherman, has compared options for measuring sound speed directly versus computing it from temperature, conductivity and pressure. The sensors used to measure sound speed on the expendable sound velocimeter (XSV) are intended for short term use and the materials selection and construction practices do not seem appropriate for a long term instrument. There are several well built and apparently reliable and accurate sound velocimeters commercially available. These are, however, substantially more expensive, comparable to the sensor portion of CTDs. Because the costs are comparable and because we believe a conductivity and temperature combination to have wider applications and to be more generally useful, we have decided to pursue the CTD sensor option first.

We gave serious consideration to three conductivity sensors. The Plessey inductive sensor (essentially the sensor from the original STD) has the advantage that there are no electrodes in contact with sea water. The coils of the sensor are, however, subject to mechanical changes which affect the calibration and they are relatively heavy and power hungry. The Sea-Bird conductivity cell has shown generally good performance and reliability. The conductivity measurement is made in a small sample tube which does not properly flush unless the sensor is drawn through the water at velocities near a meter per second or seawater is pumped through the cell; pumping is extremely power hungry and would add an energy comparable to that required to profile vertically. While these two options are viable we have decided to first try conductivity (and temperature and pressure) sensors manufactured by Ocean Sensors, a small local company which has produced a number of sensor systems for submarine use by NOSC. Their sensors are of the type originally developed for microstructure measurement at UCSD in the laboratories of Charles Van Atta and Carl Gibson, and, indeed, some of the Ocean Sensors engineers took degrees in Van Atta's lab.

We selected Ocean Sensors for initial testing because 1) the conductivity sensor has shown high reproducibility over months of operation with frequent pressure cycling when used with the Ocean Sensors' unique electronics; 2) the sensor requires no pumping, is fast (simplifying the removal of "spiking"), simple and easy to mount; 3) the associated CTD system has been favorably tested by several oceanographers and appears to be of a modern and flexible design; 4) the company is interested in working to develop something suited to our needs and to provide any portion of their system (sensors, analog electronics and/or microprocessor controller) allowing efficient integration with ALACEs; 5) the price is competitive.

At the end of the quarter we were seeking a formal quote from Ocean Sensors for a complete system for testing. First we will test for calibration shifts resulting from temperature and pressure cycling. Second we will establish

procedures for matching temperature and conductivity time scales to eliminate spiking. Finally, we will examine stability after long term high-pressure immersion. After testing we will probably use this CTD in our pressure facility to measure density (with frequent samples compared with full salinometer analysis).

At the time our proposal was written it was recognized that the original Webb Research microprocessor was not adequate for the data manipulation tasks required to compute sound speed and compress data for Argos transmission. We did not know then that the controller program also had serious coding bugs which have likely produced many of the infant mortality failures that have plagued the development of ALACE (the controller program sometimes loses the data telling when to carry out subsequent operations like starting pumping to ascend). This weakness was discovered in March when only one of two deployed ALACEs functioned. Others failed pre-launch testing and were returned to the lab for diagnosis which gave unambiguous proof of the coding error. It was decided then that, rather than attempt to re-write the Webb Research code, we should begin development of an alternate controller immediately, three months earlier than originally scheduled.

At the end of the quarter Lloyd Regier had completed design of a new controller using a 68HC11 processor programmed primarily in FORTH. We believe that this will provide the flexibility and power to gracefully deal with new sensors and missions, including the sound speed profiling called for in this project. We believe the controller will be essentially completed in the next quarter, six months ahead of schedule.